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Andreea Stoian and Laura Obreja Brasoveanu and Bogdan Dumitrescu and Iulian Brasoveanu

Department of Finance and CEFIMO, Bucharest University of Economic Studies, Department of Finance and CEFIMO, Bucharest University of Economic Studies, Department of Banking, Bucharest University of Economic Studies, Department of Finance and CEFIMO, Bucharest University of Economic Studies

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# A new framework for detecting the *short term fiscal vulnerability* for the European Union countries<sup>♦♦</sup>

**Andreea Stoian**

Department of Finance and CEFIMO  
Bucharest University of Economic Studies

**Laura Obreja Braşoveanu**

Department of Finance and CEFIMO  
Bucharest University of Economic Studies

**Bogdan Dumitrescu**

Department of Money and Banking and CARFIB  
Bucharest University of Economic Studies

**Iulian Braşoveanu**

Department of Finance and CEFIMO  
Bucharest University of Economic Studies

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## Abstract

The aim of this study is to develop a new framework ( $V-L-D$ ) for detecting the short term vulnerabilities in fiscal policy for the European Union countries. The methodology relies on two distinct indicators: one showing the vulnerabilities signalled by the size of the cyclically adjusted budget and public debt and one indicating the vulnerabilities through their annual changes.  $V-L-D$  is able to categorize fiscal vulnerability into five distinct classes having scores from 0 (no fiscal vulnerability) to 4 (extreme fiscal vulnerability). From 1990-2013, we found 310 episodes of fiscal vulnerability for the 28 European Union countries out of which 128 episodes of low vulnerability, 94 of moderate, 62 of strong and 26 of extreme fiscal vulnerability. We also explored the correlation between financial market sentiment and fiscal vulnerability. We used  $V-L-D$  as a predictor and *Credit Default Swaps (CDS)* as dependent and proxy for the market sentiment in a balanced panel model consisting in 17 European countries with random effects over the period 2008-2013. The results indicate that CDS are higher and significant for strong and extreme vulnerability periods compared with times having zero vulnerability. The CDS for low and moderate fiscal vulnerability are also higher but they are not significant, suggesting that investors overprice the risk randomly during low and moderate vulnerability. Employing a logit model for a panel consisting of 12 European countries over 2008-2013, we also found that governments are less likely to adjust fiscal policy when it is strong or extremely vulnerable and that the probability of fiscal consolidation increases when market sentiment is negative and CDS are higher.

**Keywords:** fiscal policy, budgetary deficit, fiscal sustainability, primary balance, debt dynamics, European Union

**JEL Classification:** E62, H12, H6

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## 1. Introduction

For the last decades governments worldwide have been facing various and growing challenges of fiscal policy. Reassessing the role of the government in the economy after the Great Depression as the *welfare state* led to a significant increase in the social public spending which made overall government expenditures to rise. Adema, Fron and Ladaïque (2011) showed in this sense that for the OECD countries the increase was of 20% over 1980-2007 period. Earlier, Kotlikoff and Hagist (2005) documented that healthcare public spending increased more than GDP growth rate and they concluded that if social benefits continue increasing over the next decades at the same rate, then many governments will confront large and unsustainable budgetary deficits in the long run. Corsetti and Roubini's (1996) and Alesina's (2000) argued about the negative effects of rising public social expenditures on fiscal sustainability. Fiscal policy issues have also been emphasized by an extended body of research. For instance, Wilcox (1989), Corsetti and Roubini (1991), Greiner and Semmler (1999), Afonso (2000), Afonso and Raul (2008) showed fiscal unsustainability in the long run, whereas Claeys (2007), Fatas and Mihov (2009), Afonso, Agnello, Furceri and Sousa (2009) indicated that fiscal position has not changed for the last 30 years and that fiscal policy has been mildly pro-cyclical. Recent literature (i.e. Ghosh, Kim, Mendoza, Ostry and Qureshi, 2011; Reinhart and Rogoff, 2011) has also warned about the large increase in the primary deficits and public debt over the past forty years due to financial bailouts, lower government revenues and stimulus spending.

These findings point towards the existence of some vulnerabilities in the fiscal policy which, unaddressed on short or medium term, could deteriorate its condition, hence, making it incapable to respond properly to various shocks or to achieve its objectives. Hemming, Kell and Schimmelpfennig (2003) showed that fiscal vulnerabilities were central in at least 6 of the 11 cases of crises that they investigated. In the cases of Russia and Ecuador, public sector solvency and liquidity problems culminated with the sovereign debt default, in Ukraine and Pakistan debt restructuring was negotiated under the shadow of default, and in the case of Bulgaria and Brazil, persistent and growing fiscal deficits were the main source of pressure on the currency.

The financial crisis in 2007-2008 followed by the sharp economic recession and sovereign debt crisis brought into attention the importance of fiscal policy as a relevant macroeconomic policy tool used by governments to respond to shocks and/or to recover from the crisis. In this sense, many economists (i.e. Stiglitz, 2012; Pisani-Ferry, 2012) reasoned about the contribution of an expansionary fiscal policy towards a sustainable economic growth. This is more important for the Euro zone member states as they have limited macroeconomic policy tools since the monetary policy and the exchange rate can no longer be used by governments when dealing with shocks.

In the light of the recent macroeconomic developments, the analytical work which has been conducted since 2009 by the International Monetary Fund (IMF) and the European Commission (EC) reassessed the importance of employing a toolkit for detecting fiscal vulnerabilities and anticipating the potential stresses. Thus, the aim of this paper is to develop a new framework for detecting fiscal vulnerability on the short term for the European Union countries. For this purpose, the paper is structured as follows. Section 2 presents the related literature. Section 3 defines the concept of fiscal vulnerability and describes the new proposed methodology, namely *V-L-D*. Section 4 provides the results and makes further discussions. Section 5 draws the concluding remarks of this study and some policy implications.

## 2. Related literature

Reviewing the relevant literature on this topic, we found several studies providing various frameworks or assessing fiscal vulnerabilities. In this respect, we believe that the paper of Hemming and Petrie (2000) represents the seminal work in the field. One important contribution brought by the two authors is that they formulated one explicit definition and presented and discussed the sources of fiscal vulnerability, also providing a comprehensive list of variables which could be considered for further assessment of fiscal

vulnerability. Later on, Rial and Vicente (2004) employed a sensitivity analysis in order to study the vulnerability of public debt in the case of Uruguay. The investigation conducted by the two authors is consistent with their own definition of fiscal vulnerability as representing any violation in liquidity and/or solvency requirements due to changes in the macroeconomic conditions. The methodology employed is appropriate for an economy like Uruguay which is confronted with high volatility in its macroeconomic conditions. They began the analysis from a baseline scenario and they defined additional scenarios assuming that the debt determinants (GDP growth rate, interest and exchange rate) vary (increase/decrease) by one and two standard deviations.

The macroeconomic developments since 2008 which culminated with the sovereign debt crisis in the European Union, increased the interest in the study of fiscal vulnerability. Thus, the literature has grown over the last years. In this sense, Ghezzi, Keller and Wynne (2010) developed an index of fiscal vulnerability, which incorporates debt tolerance considerations by looking at five components of vulnerability: solvency (basic debt dynamics, i.e., whether the debt ratio is stable or increasing); fiscal financing needs and debt composition; external financing dependence; financial sector health; and institutional strength. The idea is that a judgment as to whether the debt dynamics point to a possible default depends in part on the other factors.

Baldacci, McHugh and Petrova (2011) contributed to the development of a fiscal monitoring framework by employing a fiscal vulnerability index which measures the fiscal vulnerability on a continuous basis as departure from historical norms defined as 10 years country averages and a fiscal stress index to assess the country susceptibility to extreme tail events. The fiscal vulnerability index was constructed using basic fiscal variables and variables indicating long term fiscal trends and assets and liabilities management. Each variable is standardized using the 10 years average and the standard deviation for each group of countries (advanced and emerging economies) and then transformed into cumulative normal distribution. The fiscal stress index was computed firstly by defining a fiscal crisis, secondly by assessing the signalling power of each indicator using the standard approach applied in the early warning systems and in the end by calculating the number of indicators exceeding the thresholds. The shortcomings of this methodology are also noticed by the authors and concern, on one hand, the meaning of the historical norms and deviations from them in the case of the vulnerability index and, on the other hand, the specific definition of crisis events in the case of the stress index. In a later study, Baldacci, Petrova, Belhocine, Dobrescu and Mazraani (2011) conducted a more detailed and extensive investigation on fiscal stress using the same methodology as presented in Baldacci, McHugh and Petrova (2011), but compared to the former one, they built the methodology on the basis of a broader definition of fiscal crisis which also included the public debt default as well as the near default events.

BlackRock Investment Institute (2011) introduced the BlackRock Sovereign Risk Index for assessing the credit risk of sovereign debt issuers. They used several variables organized into four categories: fiscal space (debt level and structure, demography, default history, etc.); the external finance position; financial sector health; and willingness to pay (political and institutional factors). The index was computed using a weighted version of individual  $z$ -scores. This index proved to be highly correlated with the five-year Credit Default Swap (CDS) spreads. Hayes (2011) presented the Barclays Capital Fiscal Vulnerability Index (FVI) which was computed using 16 indicators of fiscal vulnerability across 57 countries. To assess fiscal vulnerability, a measure of financial market concerns about a country's debt sustainability was chosen, namely the cost of insuring against a government defaulting on its bonds, as measured by Credit Default Swap rates. A higher CDS rate indicates that investors attach a higher likelihood to a government default, and they took this to indicate a heightened probability of a financing crisis. The choice of the vulnerability indicators and of the weights given to them in the overall FVI are determined by their ability to account for cross-country variation in CDS rates. The indicators are grouped under five broad headings: solvency, government financing needs, external financing dependence, financial sector health and institutional strength and the composite index (FVI) is reported as  $z$ -score for each country. In Hayes's view, a  $z$ -score is a measure of how far one country's vulnerability is from the cross-country average and that it represents a rather relative measure of vulnerability than an absolute measure. A positive  $z$ -score indicates that the country's fiscal resilience is above average, while a negative score indicates below average resilience.

Schaechter et al (2012) developed a broader toolkit for assessing fiscal vulnerability and risks. They introduced six tools organized by their time horizon: indicators measuring short time pressures including gross financing needs, market based measures of sovereign risk default (Credit Default Swap and Relative Asset Swap) and a measure of potential spillovers (distress dependence among sovereigns), and indicators assessing medium to long run vulnerabilities comprising of a measure of the fiscal effort required to stabilize debt (the size of fiscal consolidation required); a measure of assessing the adverse impact of growth and interest shocks to the debt trajectory and a measure of the debt outlook reflecting risks associated with the baseline debt projections. For each tool, a distinct estimation technique was employed. Berti, Salto and Lequien (2012) presented an early warning index of fiscal stress named 'S0' that relies on non-parametric signals approach. They followed the existing definition of fiscal stress in order to study the key variables' behavior ahead of these episodes. They chose a signalling window and made use of the optimization criterion for determining the thresholds for fiscal risk for each variable and for the composite indicator. Compared to previous studies using a similar methodology, their original contribution is represented by the introduction of competitiveness-financial variables.

### **3. Short term fiscal vulnerability framework: methodological aspects**

Detecting fiscal vulnerability is rather difficult, but challenging. The existing literature has provided several frameworks for assessing fiscal vulnerability. The renewed focus of the IMF and the EC with this respect increased the interest in finding new ways of assessing the vulnerability of fiscal policy. In many of the previous studies, we found comprehensive and sophisticated techniques employed but, yet, they are not free of having some limitations. The contribution of this study is to provide a new framework on detecting vulnerability in the fiscal policy over the short term for the European Union countries. Much part of the relevant work in this field has focused on measuring or signalling fiscal vulnerability around episodes of fiscal crises defined, for example, as situations when there is a default or restructuring of the public debt or the governments benefit of an IMF supported program exceeding 100% of a country's quota; or the inflation rate is excessively high; or the sovereign bond yields are exceptionally high (Baldacci, McHugh and Petrova, 2011; Baldacci, Petrova, Belhocine, Dobrescu and Mazraani, 2011; Berti, Salto and Lequien, 2012).

Therefore, the aim of this research is to develop a new methodology being capable of detecting the vulnerabilities in fiscal policy over the short term, which do not necessarily imply an immediate fiscal stress (crisis). The following parable can illustrate this approach: imagine an individual who is running blood tests on annual basis in order to check the state of his health. The results can indicate a high level of sugar blood. He hasn't been diagnosed as diabetic yet, he hasn't collapsed yet, he hasn't confronted any extreme state of health yet. But the blood tests point towards a vulnerability. The physician will recommend some treatment and will keep the patient under supervision in order to avoid any further complications. The patient takes the treatment and one year later he can find that the level of sugar blood decreased significantly and that the vulnerability (threat) passed.

For the purpose of this study, one important step is to understand the concept of fiscal vulnerability. Much of the relevant literature was acknowledged in that sense (Furman and Stiglitz, 1999; Brix, Shatalov and Zlaoui, 2000; Hemming and Petrie, 2000; Detragiache and Spilimbergo, 2001; Allen, Rosenberg, Keller, Setser and Roubini, 2002; Hemming, Kell and Shimmelpfennig, 2003; Rial and Vicente, 2004; Daniel, Davis, Fouad and Van Rijckeghem, 2006; Bruglio, Cordina, Farrugia and Vella, 2008; Aizenman and Pascricha, 2010; Frankel and Saravelos, 2010; Baldacci, McHugh and Petrova, 2011; Greene, 2011; Hayes, 2011; Leiner-Killinger, 2011; Jedrzejowicz and Kozinski, 2012; Missale, 2012). Fiscal vulnerability can be determined, on one hand, by *inherent* factors such as the poor size and the composition of government revenues and expenditures, poor structure of the public debt and, weak fiscal institutions, budgeting process, government assets and liabilities management etc. which can induce a kind of *intrinsic* vulnerabilities in the fiscal policy. If these weaknesses are nurtured by the governments over the years, for electoral or other policy and political purposes, and they do not foster economic growth, then the intrinsic vulnerabilities could self-fulfil into a fiscal crisis. On the other

hand, there are *exogenous* factors such as poor economic conditions, financial sector spillovers, demographic, political or environmental changes, etc. which are not specific to fiscal policy but which could generate exogenous vulnerabilities affecting the size and/or the dynamic of fiscal variables (e.g. the latest financial crisis of 2007-2008 required substantial government aid from the state budget which went to a significant growth in the public debt exposing fiscal policy to a higher degree of vulnerability).

Studying the sources of fiscal vulnerability described in the existing literature (i.e. Hemming and Petrie, 2000; Cottarelli; Greene, 2011), the conclusion was that their effects are eventually revealed by the *size* and/or by the *changes* of the *budgetary deficit* and/or of the *public debt*. In that sense, Stoian and Iorgulescu (2014) found that central and eastern European countries registered lower public debt-to-GDP ratios and higher debt growth rates compared to the advanced economies in EU. This evidence suggested that even if one country has a small size of public debt, when its dynamics is rapidly accelerating it should represent a signal for the governments to monitor its progress over the time and to adjust accordingly the primary surplus in order to avoid unstable debt trajectories on medium term and/or in the long run.

Thus, *fiscal vulnerability* can be defined as ‘*any kind of intrinsic weakness in the existing fiscal policy or exogenous shocks that lead to a significant deterioration in the level and/or dynamics of the budgetary deficit and/or public debt over the short term that will limit the government’s ability to achieve its goals*’.

The newly developed framework for detecting fiscal vulnerability proposed in this study is consistent with this definition. We decomposed our measure of overall fiscal vulnerability ( $V$ ) into two components, one capturing the vulnerability through the size of fiscal variables while the other captures the vulnerability through their changes on two consecutive years. The former we refer to as *level indicator* ( $L$ ) while the second we refer to as the *dynamic indicator* ( $D$ ). We used the *cyclically adjusted balance* and the *public debt* both as leading fiscal variables to detect the vulnerability. Establishing the measure of fiscal vulnerability is done throughout the equation (1):

$$V = L + D \tag{1}$$

where,  $L$  and  $D$  can take values of 0, 1 and 2 as it is described below.

The *level indicator* ( $L$ ) detects the vulnerabilities signalled by the size of the *cyclically adjusted balance* ( $CAB$ ) and of the *public debt* through *distance-to-stability* ( $D-S$ ). We argue the use the *cyclically adjusted balance* by two reasons. On one hand, it includes the interest payments on public debt from previous years, thus capturing the influence of past deficits, as sources of vulnerability, on the current fiscal policy. Even if governments make efforts in achieving primary surpluses, if the interest payments are sizeable they will turn the surplus into an overall deficit. Eventually, governments will have to borrow money or raise taxation in order to finance the overall deficit. On the other hand, variations in the budget balance can give a misleading picture of the fiscal stance as an improvement of the fiscal balance during the upswings can mask a deterioration in the underlying position of the public finances (Bouthevillain and Quinet, 1999). The *distance-to-stability* measure signals the possibility of current public debt to deviate from its steady state and to have an unstable trajectory in the medium term and/or in the long run if governments do not achieve sufficient primary surpluses or do not consolidate fiscal policy in order to reduce the deficit. The estimation of  $D-S$  is based on the public debt dynamic model which is detailed in Appendix 1.  $D-S$  measures the difference between the actual primary balance and the one needed to stabilize the public debt, given the real GDP growth rate and the interest rate on public debt. A fiscal vulnerability episode signalled by the size of the cyclically adjusted balance and/or of the public debt through  $D-S$  is defined in the year when  $CAB$  is larger than a specific threshold which is determined below and/or  $D-S$  takes value of 1 as shown in the Appendix 1.

The *dynamics indicator* ( $D$ ) detects the vulnerabilities signalled by the changes for two consecutive years in the cyclically adjusted balance ( $\Delta CAB$ ) and in the public debt ( $\Delta Debt$ ), both expressed as GDP ratios. The period of two years used in the computation of the indicator of dynamic is chosen in order to diminish the influence of a temporary factor affecting the dynamic of the relevant indicators in one given year and to better picture their evolution that lead to the decision to initiate a fiscal adjustments. Moreover, taking into consideration a period of two consecutive years can capture large deterioration on short term in the leading indicators that led

to the decision to pursue the fiscal adjustment and it eventually excludes the medium term developments in the leading indicators that are not necessarily linked to the decision to embark the adjustment of fiscal policy. Raising ratios suggests that *CAB* and/or *public debt* increase faster than GDP does. A fiscal vulnerability episode signalled by the dynamic of cyclically adjusted balance and/or by the dynamic of public debt is defined in the year when the cumulated changes over two consecutive years in fiscal variables are larger than a specific threshold.

In order to establish a relevant threshold beyond which the size of the cyclically adjusted balance as well as changes in *CAB* and in public debt as GDP ratios indicate fiscal vulnerability the following approach was employed. We focused on countries which consolidated fiscal policy in order to correct the imbalances. However, we fully acknowledge that some countries could decide, for various reasons, not to tackle firmly their fiscal problems and to increase the deficit and/or to accumulate debt instead, arguing that they have the necessary fiscal space. Nevertheless, according to the ‘crisis hypothesis’, governments find much easier to stabilize decisively in times of crisis than in times of moderate economic problems (Alesina, Ardagna and Trebbi, 2006).

We studied the size of the cyclically adjusted budget and the cumulated changes for two consecutive years in *CAB* and in public debt to GDP ratios in the year before the fiscal adjustment episodes by the reason we assumed that all these indicators reached a level which triggered on average the fiscal consolidation.

A period of fiscal adjustments was defined as *a period of few consecutive years characterized by small improvements in the cyclically adjusted primary balance, which includes at least one year when the improvement was at least 1.5 per cent of GDP as in Alesina and Ardagna (2010), or a period of few consecutive years when the average improvement in the cyclically adjusted primary balance is at least 1 per cent of GDP per year.*

Using annual data over the period 1990-2013 for 28 EU countries, we found 64 episodes of fiscal adjustments (see Table 1 in the Appendix 2). The dataset used for detecting fiscal adjustments is described in the Appendix 3. Studying the values for *CAB*,  $\Delta CAB$  and  $\Delta Debt$  in the preceding year of the fiscal adjustment, we calculated the median in order to establish the threshold which indicate fiscal vulnerability. Choosing median as a relevant estimator for the purpose of this study was argued by the reason of eliminating the influence of large values recorded for some countries due, mostly, to specific circumstances. Ireland, for example, registered a 47 p.p. deterioration in the public debt to GDP ratio in 2010 compared to 2008 and a 20 p.p. deterioration of the *CAB* compared to the previous year and clearly represents an outlier. The following thresholds were evidenced: (i) a deficit of 4.7 p.p. of GDP for the cyclically adjusted budget balance; (ii) a deterioration of the *CAB* of 2.3 p.p. of GDP for two consecutive years, and (iii) an increase of the public debt to GDP ratio of 6.1 p.p. of GDP for two consecutive years. In order to detect fiscal vulnerability, we looked for values larger than the median from the upper 50% of data distribution. The level indicator (*L*) monitoring the vulnerability signalled by the size of the cyclically adjusted balance by the size of public debt through the *distance-to-stability* takes the following values:

$$L = \begin{cases} 2, & \text{if } CAB \leq -4.7 \text{ p.p. and } D - S = 1, \\ 1, & \text{if } CAB \leq -4.7 \text{ p.p. or } D - S = 1, \\ 0, & \text{if } CAB > -4.7 \text{ p.p. and } D - S = 0 \end{cases} \quad (2)$$

The dynamics indicator (*D*) monitoring the vulnerability signalled by the changes for two consecutive years in *CAB* and in the public debt years takes the following values:

$$D = \begin{cases} 2, & \text{if } \Delta CAB \geq 2.3 \text{ p.p. and } \Delta Debt \geq 6.1 \text{ p.p.}, \\ 1, & \text{if } \Delta CAB \geq 2.3 \text{ p.p. or } \Delta Debt \geq 6.1 \text{ p.p.}, \\ 0, & \text{if } \Delta CAB < 2.3 \text{ p.p. and } \Delta Debt < 6.1 \text{ p.p.} \end{cases} \quad (3)$$

Finally, using *V-L-D* framework, five categories of fiscal vulnerability (*V*) can be established as in (4):

$$V = \begin{cases} 4, \text{indicating extreme fiscal vulnerability} \\ 3, \text{indicating strong fiscal vulnerability} \\ 2, \text{indicating moderate fiscal vulnerability,} \\ 1, \text{indicating low fiscal vulnerability} \\ 0, \text{indicating no fiscal vulnerability} \end{cases} \quad (4)$$

For instance, when  $V$ - $L$ - $D$  indicates extreme fiscal vulnerability, it implies that both the level and the dynamics indicators signal vulnerabilities in the fiscal policy. In this situations, fiscal consolidation is strongly required. When  $V$  is zero, the situation corresponds with states of non-vulnerability. When  $V$  takes values of 3, 2 or 1, both and/or only one of the indicators ( $L$  or  $D$ ) detect vulnerabilities in fiscal policy.  $V$ - $L$ - $D$  framework has the advantage of detecting fiscal vulnerability over the short term using data reported for the current year and for the previous two years. Thus, governments could use the information provided by  $V$ - $L$ - $D$  in order to correct the fiscal policy for the next year or during the same year, if there is enough data to calculate  $V$ . We also believe that  $V$ - $L$ - $D$  represents a tool which allows governments to make fiscal adjustments in real time. Human beings have a natural disposition to procrastinate the moments when they have to make changes. This is also true for governments' behaviour which prefer to postpone the fiscal consolidation. Buiter (2004) explaining why policy makers prefer running Ponzi schemes and roll over the public debt instead of smoothly adjusting fiscal policy argued that when there is no terminal date, or even if there is one but it is far in the future and there is an obvious temptation for a debtor to put off the day of reckoning as long as possible and even after 200 years of deficits the debtor can always argue that it has all the rest of eternity to run the necessary primary surpluses. A forward looking methodology of assessing fiscal vulnerability would indicate the potential risks at which fiscal policy could be exposed only a few years later. It depends only on the governments to decide whether they make the necessary adjustment to avoid the long term risks. When  $V$ - $L$ - $D$  signals the fiscal vulnerability, it also warns governments that fiscal policy should be adjusted.

#### 4. Results and discussions

The  $V$ - $L$ - $D$  framework for detecting short term overall fiscal vulnerability for the EU countries was employed on a dataset over the period 1990-2013 for 28 countries of the European Union. The data set is described in the Appendix 3. The total number of observations was 516.  $V$ - $L$ - $D$  indicated 310 episodes (years) of fiscal vulnerability out of which 26 episodes of extreme vulnerability, 62 episodes of strong vulnerability, 94 episodes of moderate vulnerability and 128 episodes of low vulnerability (see Table 2 in the Appendix 2). For the rest of 206 observations,  $V$ - $L$ - $D$  detected no fiscal vulnerability: Studying the overall vulnerability for 2014 and 2015 (see Table 3 and Table 4 in the Appendix 2), we can observe that in 2014 only for Greece, the  $V$ - $L$ - $D$  detected strong fiscal vulnerability, whilst in 2015 Slovenia is the only country indicated as having strong fiscal vulnerability. For rest of the European Union countries, our framework mostly indicates low and moderate vulnerability. Analysing the decomposed vulnerability for Greece's case in 2014, we find that the dynamic indicator ( $D$ ) shows increases in the cyclically adjusted balance and public debt-to-GDP ratios for the last two years whereas the level indicator signals stabilizing debt issues. This is the information which  $V$ - $L$ - $D$  provides. What should Greek government do with it? The *distance-to-stability* suggests that public debt still diverges from the steady state and not addressing this aspect by reaching larger primary surplus could deteriorate fiscal sustainability. Also the cumulated changes in the debt ratio show an appropriate dynamic in short run. The overall fiscal vulnerability in 2015 decreases from 3 to 1 with zero vulnerability for the size and changes in the public debt. This indicates that Greek governments will take serious measures in order to decrease the debt ratio. The forecast show that in 2015 debt will reduce from 175% to GDP in 2014 to 168% to GDP reaching to 157% to GDP in 2016 according to the data provided by Ameco. However, the dynamic indicator still detects some vulnerabilities for the cyclically adjusted balance and its changes over the last two years. Therefore, this aspect should be further monitor by Greek governments and eventually avoid increasing the deficit before it can be signalled by the level indicator.



In order to check if  $V-L-D$  sends the right signals, we explored the correlation between the financial markets sentiment and the  $V-L-D$  results for overall fiscal vulnerability as predictor. For this purpose, we employed a balanced panel model with random effects and one categorical variable over the period 2008-2013. The model is described by equation (5):

$$Y_{it} = \alpha + \beta_j D_j + \gamma Z_{it} + \varepsilon_{it} \quad (5)$$

where:

$Y_{it}$  is the Credit Default Swap defined as dependent variable for country  $i$  at time  $t$ ;

$D_j$  is overall fiscal vulnerability which takes values of 0, 1, 2, 3 and 4 and it is defined as a categorical variable,  $j = \overline{0,4}$ ;

$Z_{it}$ : set of control variables for country  $i$  at time  $t$  represented by the nominal GDP growth rate and by the trade deficit;

$\alpha$  is the constant;

$\beta_j$  is the coefficient of category  $j$  of factor variable;

$\gamma$  is the coefficient of control variable;

$\varepsilon_{it}$  is the error term.

The five-years CDS in US dollars at the end of the year used as a dependent variable in the equation (5) is a proxy for the market sentiment. The categorical variable (*vulnerability*) is the variable of interest and is represented by  $V$  as in equation (4). Being a categorical variable it is displayed in 5 distinct categories depending on the vulnerability score. Some descriptive statistics are reported in Table 2. The nominal GDP growth rate (*growth*) accounting for the domestic economic condition and the trade deficit of goods and services as GDP ratio (*external*) accounting for the external imbalances were introduced as control variables. The use of control variables was argued by robustness check reasons.

Table 2 Fiscal vulnerability categories, 2008-2013

<i>Vulnerability</i>	Freq.	Percent	Cum.
0	16	15.69	15.69
1	22	21.57	37.25
2	28	27.45	64.71
3	24	23.53	88.24
4	12	11.76	100.00
Total	102	100.00	

The panel consists of 17 EU countries: Bulgaria, Denmark, the Netherlands, France, Finland, Germany, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovenia, Slovakia, Spain and Sweden for which we found available data during 2008-2013. The data for CDS was collected from Reuters and the data for the GDP growth rate and for the trade deficit were provided by Ameco.

Three distinct equations were estimated. In the first regression (5.1), only the correlation between the market sentiment and the fiscal vulnerability was explored. In the second (5.2) and the third regression (5.2), control variables were added in order to check if the relationship between market sentiment and the fiscal vulnerability still holds. Investors could ask for a higher risk premium not only when they believe that governments confront with an increased exposure to solvency risk due to debt accumulation, but also when the economic

conditions are bad and when the countries are exposed to external shocks due to a poor trade balance also combined with a deterioration of fiscal conditions.

$$CDS_{it} = \alpha + \beta_j D_j + \varepsilon_{it} \quad (5.1)$$

$$CDS_{it} = \alpha + \beta_j D_j + \gamma growth_{it} + \varepsilon_{it} \quad (5.2)$$

$$CDS_{it} = \alpha + \beta_j D_j + \gamma_1 growth_{it} + \gamma_2 external_{it} + \varepsilon_{it} \quad (5.3)$$

The panel was estimated using GLS method and random effects as indicated by the Hausman test and using zero fiscal vulnerability as the base category for the categorical variable. The results are reported in Table 3.

Table 3 Random effects GLS regression

Panel 1			
Variables	(1)	(2)	(3)
<i>Vulnerability</i>			
1	-16.62 (60.21)	10.41 (58.61)	8.006 (59.12)
2	53.85 (59.03)	100.7* (59.07)	94.55 (58.80)
3	99.41* (60.16)	144.1** (59.87)	138.0** (59.74)
4	118.1* (71.28)	193.1*** (73.51)	200.9*** (74.21)
<i>growth</i>		9.666*** (3.293)	7.059* (3.661)
<i>external</i>			-6.538** (3.168)
<i>constant</i>	148.9*** (50.59)	91.59* (52.84)	106.1** (50.95)
Hausman test			
Prob> $\chi^2$	0.1764	0.5661	0.3661
R-sq	0.0914	0.1623	0.2093

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results show that financial markets react to strong and extreme fiscal vulnerability by increasing the CDS. These two categories are significant for each regression employed suggesting a robust relationship between market sentiment and a heavy deterioration of the fiscal policy. When using a categorical variable as explanatory, a base category has to be set up for comparison. Thus, the estimated coefficients indicate how much the dependent variable corresponding to category  $j$  is larger than the dependent variable corresponding to the base category. Taking, for instance, regression (5.3) as an example, the coefficients indicate that CDS in situation of extreme fiscal vulnerability (denoted by category 4) is 200 points higher than CDS in situations when fiscal policy is not vulnerable. The CDS for categories 3 and 4 of fiscal vulnerability are larger than the CDS for the base category and are statistically significant and hold for all regressions. Concerning the categories of low (1) and moderate (2) fiscal vulnerability, the panel indicates that even if CDS are higher compared with the base category (zero vulnerability), the coefficients are not statistically significant. This suggests that investors' beliefs concerning the risk induced by low and moderate fiscal vulnerability are somehow similar with the situation when fiscal policy is not vulnerable. Thus, they don't systemically ask for higher risk premium during periods with low and moderate vulnerability as they do for situations when fiscal policy is signalled as being strong or extremely vulnerable, but randomly. These findings are consistent with De Grauwe and Ji (2012) who suggested that during boom years, investors are pricing favourable the sovereign risk compared with times of crisis when, driven by panic, they usually overprice the risk. The authors also

advocate that financial markets behaviour influences governments' response to fiscal vulnerability. During economic flourishing when investors are optimistic and are more prone to underpricing the risk, governments are not stimulated to adjust fiscal policy even if it gives signal of vulnerability. Large deterioration of economic and of fiscal conditions which are assessed as fiscal stress lead to a change in market sentiment in the sense of increasing sovereign risk. Thus, government will have to consolidate fiscal policy.

We also studied government's reaction of adjusting fiscal policy in times of vulnerability. In this sense, we employed a logit model for balanced panel data using as dependent a dummy variable (*adjustment*) which takes value of 1 for the years when we identified episodes of fiscal adjustments (see Table 1 in the Appendix 2) and 0 otherwise. Equation (6) describes the model:

$$\Pr(Y_{it} = 1|X_{it}) = F(\beta_0 + \beta_1 X_{it}) \quad (6)$$

where:

$Y_{it}$  is the dependent variable describing the fiscal adjustment for country  $i$  and time  $t$  which takes values of 0 and 1;

$X_{it}$  is the set of explanatory variable for country  $i$  and time  $t$  represented by the overall adjusted vulnerability or the *CDS*;

$\beta_0, \beta_1$  represent the coefficients to be estimated.

Two distinct equations were estimated. Equation (6.1) investigates whether the probability of adjusting fiscal policy increases with the change in the status of overall fiscal vulnerability from one category to another. This should be consistent with the 'crisis hypotheses'. Thus, we used as predictor a categorical variable (*adjusted vulnerability*) with 2 distinct categories: 0 and 1. The decision to reshape the original categorical variable (*vulnerability*) used in Panel 1 lied on previous results which made us conclude that financial markets find more relevant the situations characterized by strong and extreme vulnerability. This new variable which was introduced in equation (6.1) aims at revealing if the probability of adjusting fiscal policy increases when fiscal vulnerability changes from low and moderate to strong and extreme. In this case, the base is represented by the zero category which corresponds to low and moderate fiscal vulnerability. Equation (6.2) explores the correlation between the probability of taking fiscal consolidation when fiscal policy is vulnerable, but also controlling for the market sentiment (*CDS*).

$$\Pr(\text{adjustment}_{it} = 1|\text{adjusted vulnerability}_j) = F(\beta_0 + \beta_1 \text{adjusted vulnerability}_j) \quad (6.1)$$

$$\Pr(\text{adjustment}_{it} = 1|CDS_{it}) = F(\beta_0 + \beta_1 \text{adjusted vulnerability} + \beta_2 CDS_{it}) \quad (6.2)$$

Both equations are estimated using a balanced panel data consisting of 12 European Union countries: Denmark, the Netherlands, France, Germany, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia and Spain over 2008-2013 period. Compared to panel 1, from panel 2 we dropped Bulgaria, Finland, France, Ireland and Sweden for which we observed no change in *adjustment* or in *adjusted vulnerability* during the period investigated. We used annual average for *CDS* assuming that it will be more relevant for our investigation, if we take into account that fiscal adjustments could be undertaken throughout the year. The results are reported in Table 4:

Table 4 Random effects logit regression

Variables	Panel 2		Odds ratio	
	(1)	(2)	(1)	(2)
<i>adjusted vulnerability</i>				
1	-1.951*** (0.714)	-3.748*** (1.070)	0.142*** (0.101)	0.023*** (0.025)
<i>CDS</i>		0.0134*** (0.00397)		1.013*** (0.004)
<i>constant</i>	0.526 (0.373)	-1.147** (0.519)	1.692 (0.630)	0.317** (0.164)
Observations	72	72		

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results indicate that the probability of consolidating fiscal policy when vulnerability goes from ‘low and moderate’ to ‘strong and extreme’ decreases. When adding the control variable, we find that the odds of taking fiscal adjustments increase when the market sentiment becomes poorer. This result is consistent with De Grauwe and Ji (2012)’ who suggested that governments are more willing to consolidate when market sentiment is negative. Our findings do not reject the ‘crisis hypothesis’. They just show that governments are less likely to take fiscal adjustments in times of strong and extreme vulnerability. According to our observations of the data (see Table 5 in the Appendix 2), governments consolidate fiscal policy within few years after strong and extreme vulnerability episodes, when cautious investors are still pricing high the sovereign risk and CDS are still large. This is the reason why we found lower probability of consolidation in times of strong and extreme vulnerability and higher probability when CDS are raising. Moreover, the theory also suggests the existence of various lags (recognition, decision, implementation, and impact) between the time when the problem occurs and the time when policy responds. We can also assume that over periods with fiscal stress, governments might adjust fiscal policy in the sense of a slight improvement of the adjusted primary balance but not in the sense defined in this paper or in the sense found in the literature.

## 5. Conclusions

Along with the increased interest in assessing fiscal vulnerability for the last years, this paper made its contribution by introducing a new framework (*V-L-D*) for detecting short term fiscal vulnerability for the European Union countries. *V-L-D* consists of two indicators: one level indicator signalling the vulnerabilities coming from the size of the cyclically adjusted balance and the public debt and one dynamic indicator capturing the vulnerabilities generated by their changes in the short run. Many of the existing studies researching the assessment of fiscal vulnerability have relied on identifying thresholds for various fiscal or financial variables thought to influence fiscal vulnerability, but many of these thresholds have been estimated based on historical norms. In return, our research provides a fiscal vulnerability indicator which is constructed using thresholds that are identified from periods when governments decided to pursue on fiscal consolidation implying that they confronted some kind of fiscal distress which did not necessarily led to a fiscal crisis.

The *V-L-D* categorizes fiscal vulnerability into five classes having scores from zero, which corresponds to non-vulnerability up to 4 which indicate extreme fiscal vulnerability. *V-L-D* detects short term fiscal vulnerability because it relies on data collected for the current year and for previous two years. We believe that governments are short sighted and even if the forward-looking methodologies of assessing fiscal vulnerability detect some vulnerabilities over the next few years, governments will generally not consolidate fiscal policy in the present to address in advanced that particular issue, but when the distress cannot be avoided anymore. This is the reason why, we decided to emphasize more what happened in the recent past. Governments could

use the information provided by *V-L-D* in order to make changes in fiscal policy to avoid increasing exposure to various risks. Additionally, *V-L-D* could provide useful information for investors when pricing the sovereign risk.

In order to test the relevance and the usefulness of this framework, we explored the correlation between financial market sentiment and fiscal vulnerability. We conducted this investigation on a balanced panel of 17 EU countries during 2008-2013. The results showed that market sentiment turns negative when fiscal policy is strongly or extremely vulnerable. Thus, the investors will increase CDS spreads asking for higher risk premium when fiscal conditions are severely deteriorating.

Additionally, we employed a logit panel model with random effects in order to explore if governments are adjusting fiscal policy when it is signalled as vulnerable. Using a panel of 12 EU countries during 2008-2013, we found that governments are less likely to adjust during strong and extreme fiscal vulnerability, but more prone to adjustment when market sentiment becomes negative and when the CDS are increasing.

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## APPENDIX 1: *Distance-to-Stability (DS)*

The dynamics of public debt can be described starting with the one period budget constraint:

$$B_t = B_{t-1} + i \cdot B_{t-1} + PB_t \quad (1)$$

where:  $B_{t-1}$  = nominal general government debt at the end of year  $t-1$ ;  $i$  = nominal interest rate paid on government debt;  $PB$  = primary balance which equals primary government expenditures less tax revenues.

The dynamics of public debt-to-GDP ratio can be derived from equation (1) by division through  $Y_t$ :

$$\frac{B_t}{Y_t} - \frac{B_{t-1} \cdot Y_{t-1}}{Y_{t-1} \cdot Y_t} = i \cdot \frac{B_{t-1} \cdot Y_{t-1}}{Y_{t-1} \cdot Y_t} + \frac{PB_t}{Y_t} \quad (2)$$

where  $Y_t$  = GDP at current prices.

With small letters for ratios to GDP and  $y$  the growth rate of nominal GDP, equation (2) can be rewritten as:

$$b_t - b_{t-1} \cdot \frac{1}{1+y} = b_{t-1} \cdot \frac{i}{1+y} + pb_t \quad (3)$$

Hence, the public debt ratio evolves according to:

$$b_t = \frac{1+i}{1+y} \cdot b_{t-1} + pb_t \quad (4)$$

Now, if government aims at stabilizing the public debt, the condition is that:  $b_t = b_{t-1}$  which is consistent with the steady state of public debt to GDP ratio. Keeping the debt on a stable trajectory avoids or diminish the risk of running an unsustainable fiscal policy in the long run:

$$b_t = \frac{1+i}{1+y} \cdot b_t + pb_t \quad (5)$$

Using equation (5), we can estimate the primary balance ( $pb_t^*$ ) which allows fulfilling the debt stabilization as in:

$$pb_t^* = \frac{i-y}{1+y} \cdot b_t \quad (6)$$

The *distance-to-stability* represent the difference between the actual and the stabilizing primary balance:

$$D - S = pb_t - pb_t^* \quad (7)$$

It indicates if governments are able to achieve the required primary surplus in order to avoid putting the debt on an unstable path. If  $D-S$  is negative, this can create the condition that the public debt to diverge from its steady state. Thus, we have two distinct situations:

$$D - S = \begin{cases} 0, & \text{if } pb_t \geq pb_t^* \\ 1, & \text{if } pb_t < pb_t^* \end{cases} \quad (8)$$

In the case when  $D-S$  takes value 0 this indicates that governments managed to stabilize public debt and the absence of fiscal vulnerability and when  $D-S$  takes value 1 this show that the government failed in achieving stabilization and that the level of public debt could induce fiscal discomfort due to a temporarily departure from its steady state.



## APPENDIX 2: *Tables*

Table 1 Fiscal adjustments episodes, 1990-2013

Country	Year	Country	Year
Belgium	1993; 2006; 2012:2013	Lithuania	2010:2013
Bulgaria	2003:2004; 2010:2012	Luxembourg	2000:2001; 2005:2008
Czech Republic	2004; 2010:2013	Hungary	1999:2000; 2003:2004; 2007:2012
Denmark	2003:2004; 2013	Malta	1999:2000; 2004:2005; 2009
Germany	1992:1994; 1996; 2000; 2011:2012	The Netherlands	1993; 1996; 2004:2005; 2011:2013
Estonia	2000; 2009:2010	Austria	1996:1997; 2001; 2005; 2011:2013
Ireland	2000; 2003:2004; 2011:2013	Poland	2011:2012
Greece	1991; 1996; 2005; 2010:2011	Portugal	1992; 2003:2004; 2006:2007; 2011:2013
Spain	1996:1997; 2010:2013	Romania	2010:2012
France	1996; 2011:2013	Slovenia	2012
Croatia	2012:2013	Slovakia	2011:2013
Italy	1991:1993; 1995:1997; 2007; 2011:2013	Finland	1996:1998; 2000
Cyprus	2000; 2004:2007; 2012:2013	Sweden	1996:1998; 2000
Latvia	2000:2001; 2009:2012	United Kingdom	1994:1998; 2001; 2010:2012

Table 2 Episodes of fiscal vulnerability, 1990-2013

Country	<i>Extreme</i> - Year(s)	<i>Strong</i> – Year(s)	<i>Moderate</i> - Year(s)	<i>Low</i> – Year(s)
Belgium	-	1993; 2009	1992	1994; 1996; 2005; 2010:2013
Bulgaria	-	-	2009	2010:2013
Czech Republic	2001:2002	2009	2003; 2010:2012	1999:2000; 2004:2006; 2008; 2013
Denmark	-	2010	1993; 2009	1992; 1994; 2011:2012
Germany	1995	2010	1993; 1996; 2002; 2009	1994; 1997:1999; 2001; 2003:2005
Estonia	-	-	1999; 2008	1998; 2009; 2012
Ireland	2008:2010	2011:2013	-	2002; 2007
Greece	2009	1992:1993; 2004:2005; 2008; 2010:2011	1994; 2001; 2006:2007; 2012:2013	1995:1997; 2000; 2003
Spain	2009	2008; 2010:2012	2013	-
France	-	1993; 1995; 2003; 2009:2010	1992; 1994; 1996; 2011:2013	1990:1991; 1997:1998; 2002; 2004:2005; 2008
Croatia	-	2011	2011:2012	-
Italy	-	1992:1994	1990:1991; 1996; 2005; 2009:2010; 2012:2013	1995; 2001; 2003; 2006; 2008; 2011
Cyprus	2003; 2010	2009; 2011:2012	2013	2002
Latvia	2008	2009	1999; 2010	2000:2003; 2007
Lithuania	2009	2008	1999:2000; 2010:2011	2001:2002; 2012:2013
Luxembourg	-	-	1992; 2009	2002:2004; 2008
Hungary	2006	2002:2003	2004:2005; 2007:2010	1999; 2012
Malta	1997; 2003	1998:1999; 2008	1996; 2004;	2000:2002; 2009; 2011:2012
The Netherlands	-	1995; 2009	2002; 2010; 2012:2013	1992:1993; 2003:2004; 2008; 2011
Austria	-	1995; 2009:2010	1994; 2004	1993; 1996:1997; 2003; 2012:2013
Poland	2010	2009	2003; 2008	1997:1998; 2001:2002; 2004:2006; 2012:2013
Portugal	2005; 2009:2010	1994	1993; 1995:1996; 2001:2002; 2006; 2011:2013	1992; 1998; 2003:2004; 2008
Romania	2009	2007:2008; 2010:2011	2012	2006
Slovenia	2013	2009:2011	2012	2000:2001; 2003:2005; 2008
Slovakia	2000; 2010	1999; 2009	2001:2002; 2011:2013	2008
Finland	-	1992:1993; 2009:2010;	1991; 1994; 2013	1995:1996; 2012
Sweden	-	-	-	1996; 2002; 2009; 2011; 2013
United Kingdom	1993; 2009:2010	1992; 1994; 2008; 2011	1995; 2002:2003; 2012:2013	1996; 2004:2007

Table 3 Fiscal vulnerability in 2014

Country	Overall vulnerability ( $V$ )	Distance- to- stability ( $D-S$ )	Cyclically adjusted balance ( $CAB$ )	Changes in public debt ( $\Delta Debt$ )	Changes in CAB ( $\Delta CAB$ )
Belgium	0	0	0	0	0
Bulgaria	1	0	0	1	0
Czech Republic	1	0	0	0	1
Denmark	1	0	0	0	1
Germany	1	1	0	0	0
Estonia	1	1	0	0	0
Ireland	2	1	0	0	1
Greece	3	1	0	1	1
Spain	2	0	0	1	1
France	0	0	0	0	0
Croatia	1	0	0	1	0
Italy	0	0	0	0	0
Cyprus	2	0	0	1	1
Latvia	1	1	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Hungary	1	1	0	0	0
Malta	1	1	0	0	0
Netherlands	0	0	0	0	0
Austria	2	1	0	1	0
Poland	0	0	0	0	0
Portugal	1	1	0	0	0
Romania	0	0	0	0	0
Slovenia	2	1	0	1	0
Slovakia	0	0	0	0	0
Finland	1	0	0	1	0
Sweden	1	1	0	0	0
United Kingdom	1	0	1	0	0

Table 4 Fiscal vulnerability in 2015

Country	Overall vulnerability ( $V$ )	Distance- to- stability ( $D-S$ )	Cyclically adjusted balance ( $CAB$ )	Changes in public debt ( $\Delta Debt$ )	Changes in CAB ( $\Delta CAB$ )
Belgium	1	1	0	0	0
Bulgaria	2	1	0	1	0
Czech Republic	1	1	0	0	0
Denmark	1	1	0	0	0
Germany	0	0	0	0	0
Estonia	1	1	0	0	0
Ireland	0	0	0	0	0
Greece	1	0	0	0	1
Spain	2	1	0	1	0
France	1	1	0	0	0
Croatia	2	1	0	1	0
Italy	1	1	0	0	0
Cyprus	2	1	0	1	0
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Hungary	0	0	0	0	0
Malta	0	0	0	0	0
Netherlands	1	1	0	0	0
Austria	0	0	0	0	0
Poland	1	1	0	0	0
Portugal	0	0	0	0	0
Romania	1	1	0	0	0
Slovenia	3	1	0	1	1
Slovakia	1	1	0	0	0
Finland	1	1	0	0	0
Sweden	0	0	0	0	0
United Kingdom	1	1	0	0	0

Table 5 Credit Default Swaps, Fiscal vulnerability, Fiscal adjustments, 2008-2013

Year	Country	CDS	Fiscal vulnerability	Fiscal adjustment
2008	Denmark	108.29	No	No
2009	Denmark	57.89	No	No
2010	Denmark	29.10	<b>Yes</b>	No
2011	Denmark	63.72	No	No
2012	Denmark	80.01	No	No
2013	Denmark	17.61	No	<b>Yes</b>
2008	Netherlands	25.48	No	No
2009	Netherlands	55.66	<b>Yes</b>	No
2010	Netherlands	44.60	No	No
2011	Netherlands	62.73	No	<b>Yes</b>
2012	Netherlands	66.00	No	<b>Yes</b>
2013	Netherlands	115.18	No	<b>Yes</b>
2008	France	50.93	No	No
2009	France	40.81	<b>Yes</b>	No
2010	France	66.28	<b>Yes</b>	No
2011	France	72.63	No	<b>Yes</b>
2012	France	72.63	No	<b>Yes</b>
2013	France	72.63	No	<b>Yes</b>
2008	Germany	15.24	No	No
2009	Germany	37.47	No	No
2010	Germany	39.77	<b>Yes</b>	No
2011	Germany	65.58	No	<b>Yes</b>
2012	Germany	68.61	No	<b>Yes</b>
2013	Germany	30.70	No	No
2008	Latvia	332.26	<b>Yes</b>	No
2009	Latvia	703.82	<b>Yes</b>	<b>Yes</b>
2010	Latvia	360.27	No	<b>Yes</b>
2011	Latvia	258.60	No	<b>Yes</b>
2012	Latvia	232.56	No	<b>Yes</b>
2013	Latvia	114.23	No	No
2008	Lithuania	247.59	<b>Yes</b>	No
2009	Lithuania	484.02	<b>Yes</b>	No
2010	Lithuania	262.39	No	<b>Yes</b>
2011	Lithuania	258.24	No	<b>Yes</b>
2012	Lithuania	222.45	No	<b>Yes</b>
2013	Lithuania	118.27	No	<b>Yes</b>
2008	Poland	98.22	No	No
2009	Poland	190.42	<b>Yes</b>	No
2010	Poland	131.24	<b>Yes</b>	No
2011	Poland	193.17	No	<b>Yes</b>
2012	Poland	172.81	No	<b>Yes</b>
2013	Poland	86.43	No	No

Table 5 (continued)

Year	Country	CDS	Fiscal vulnerability	Fiscal adjustment
2008	Portugal	51.10	No	No
2009	Portugal	80.21	<b>Yes</b>	No
2010	Portugal	291.49	<b>Yes</b>	No
2011	Portugal	852.11	No	<b>Yes</b>
2012	Portugal	880.92	No	<b>Yes</b>
2013	Portugal	392.98	No	<b>Yes</b>
2008	Romania	301.21	<b>Yes</b>	No
2009	Romania	388.82	<b>Yes</b>	No
2010	Romania	298.25	<b>Yes</b>	<b>Yes</b>
2011	Romania	310.59	<b>Yes</b>	<b>Yes</b>
2012	Romania	344.15	No	<b>Yes</b>
2013	Romania	198.85	No	No
2008	Slovakia	55.37	No	No
2009	Slovakia	106.00	<b>Yes</b>	No
2010	Slovakia	79.55	<b>Yes</b>	No
2011	Slovakia	147.84	No	<b>Yes</b>
2012	Slovakia	205.34	No	<b>Yes</b>
2013	Slovakia	90.20	No	<b>Yes</b>
2008	Slovenia	50.30	No	No
2009	Slovenia	98.78	<b>Yes</b>	No
2010	Slovenia	72.68	<b>Yes</b>	No
2011	Slovenia	174.57	<b>Yes</b>	No
2012	Slovenia	361.21	No	<b>Yes</b>
2013	Slovenia	296.97	<b>Yes</b>	No
2008	Spain	66.49	<b>Yes</b>	No
2009	Spain	93.12	<b>Yes</b>	No
2010	Spain	203.44	<b>Yes</b>	<b>Yes</b>
2011	Spain	318.19	<b>Yes</b>	<b>Yes</b>
2012	Spain	426.15	<b>Yes</b>	<b>Yes</b>
2013	Spain	232.96	No	<b>Yes</b>

## APPENDIX 3: *Dataset*

For the purpose of our study we used a dataset consisting in annual data for several key fiscal variables for 28 countries of the European Union. The data was provided by Ameco. The complete list of the variables included in our investigation is presented below:

### (1) Variables used for calculating *distance-to-stability*:

- $b_t$  is the general consolidated gross debt-to-GDP ratio at time  $t$ ;
- $pb_t$  is the primary balance-to-GDP ratio at time  $t$  (net lending (+) or net borrowing (-));
- $y$  is the GDP growth rate calculated as the percentage variation of the GDP;
- $i$  is the implicit interest rate on public debt (the interest payments for current year ratio to the public debt from previous year).

### (2) Variables used for identifying the *fiscal adjustments episodes*:

- Cyclically adjusted primary balance percentage to potential GDP.

### (3) Variables used in calculating *V* employing *V-L-D* framework:

- General government consolidated gross debt-to-GDP ratio;
- Cyclically adjusted balance percentage to potential GDP.

The dataset ranges from 1990 to 2013. But, considering that our investigation develops on multiple layers, that it takes into consideration several variables and that it includes 28 countries, the data might not be available for the entire range. In the table below, we present the dataset used for each country and for each of the three important stages of our analysis: identifying the *Fiscal adjustments* episodes; establishing the *Threshold* for *CAB* and *Debt*; establishing the final scores for the overall *Vulnerability*.

Country	Period				Country	Period			
	Fiscal adjustment	Threshold		Vulnerability		Fiscal adjustment	Threshold		Vulnerability
		CAB	Debt				CAB	Debt	
Belgium	1990:2013	1990:2013	1990:2013	1992:2013	Lithuania	1997:2013	1998:2013	1995:2013	1999:2013
Bulgaria	2002:2013	2002:2013	1997:2013	2003:2013	Luxembourg	1990:2013	1990:2013	1990:2013	1992:2013
Czech Republic	1997:2013	1997:2013	1995:2013	1999:2013	Hungary	1997:2013	1997:2013	1995:2013	1999:2013
Denmark	1990:2013	1990:2013	1990:2013	1992:2013	Malta	1995:2013	1995:2013	1995:2013	1997:2013
Germany	1990:2013	1990:2013	1991:2013	1993:2013	The Netherlands	1990:2013	1990:2013	1990:2013	1992:2013
Estonia	1995:2013	1995:2013	1995:2013	1997:2013	Austria	1990:2013	1990:2013	1990:2013	1992:2013
Ireland	1990:2013	1990:2013	1990:2013	1992:2013	Poland	1995:2013	1995:2013	1995:2013	1997:2013
Greece	1990:2013	1990:2013	1990:2013	1992:2013	Portugal	1990:2013	1990:2013	1990:2013	1992:2013
Spain	1995:2013	1995:2013	1990:2013	1997:2013	Romania	2002:2013	2002:2013	1995:2013	2004:2013
France	1990:2013	1990:2013	1990:2013	1980:2013	Slovenia	1998:2013	1998:2013	1995:2013	2000:2013
Croatia	2009:2013	2009:2013	2009:2013	2011:2013	Slovakia	1997:2013	1997:2013	1995:2013	1999:2013
Italy	1990:2013	1990:2013	1990:2013	1986:2013	Finland	1990:2013	1990:2013	1990:2013	1992:2013
Cyprus	1998:2013	1998:2013	1995:2013	2000:2013	Sweden	1993:2013	1993:2013	1994:2013	1996:2013
Latvia	1997:2013	1997:2013	1995:2013	1999:2013	UK	1990:2013	1990:2013	1990:2013	1992:2013